THE PLANT DISEASE REPORTER

Issued By

THE PLANT DISEASE SURVEY

Division of Mycology and Disease Survey

BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING

AGRICULTURAL RESEARCH ADMINISTRATION

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SUPPLEMENT 167

AN EVALUATION OF CERTAIN PHASES OF THE
EMERGENCY PLANT DISEASE PREVENTION PROJECT

Supplement 167

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The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Division of Mycology and Disease Survey serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

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THE PLANT DISEASE SURVEY
DIVISION OF MYCOLOGY AND DISEASE SURVEY

Plant Industry Station Beltsville, Maryland

AN EVALUATION OF CERTAIN PHASES OF THE EMERGENCY PLANT DISEASE PREVENTION PROJECT[1]

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INTRODUCTION

Agriculture's World War II slogan, "Food will win the war and write the peace", emphasizes the vital necessity of maintaining food production during time of war. Food crops are subject to attack by many enemies even in ordinary times, and an epiphytotic in a mainstay crop during time of war could have serious or even disastrous results, as instanced by the devastating outbreak of late blight in the German potato crop in 1917 that is believed to have been an important factor in Germany's economic breakdown leading to the end of World War I.

These considerations, and the fact that food crop production would be especially vulnerable to deliberate sabotage if not protected against it, led to the initiation of the Emergency Plant Disease Pre-

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[1] Although the Project was officially terminated June 30, 1945, this report has been delayed, chiefly for two reasons: (1) Previous commitments for some of this subject matter to be incorporated in an article for the current United States Department of Agriculture Yearbook. (2) It was anticipated that the War Department would lift restrictions relating to Biological warfare and thus make available to the public an interesting and perhaps important phase of the work.

vention Project by the Plant Disease Survey, July 1, 1943. The project was approved by the Secretary of War and supported from emergency funds made available by the President. Broadly stated, the purpose of this project was to help protect the country's food, feed, fiber, and oil supplies by insuring immediate detection of enemy attempts at crop destruction through the use of plant diseases, and by providing production specialists and extension workers with prompt and accurate information regarding outbreaks of plant diseases, whether introduced inadvertently or by design while still in incipient stages.

Virulent strains of pathogenic organisms, if distributed in regions of high concentrations of food crops at a time of prevailing favorable weather, could within a short period of time accomplish the destruction of much of the yield. The freedom of movement in this country, the possibility of introduction and distribution of disease inoculum by aircraft or by torpedoed cargoes, transportation difficulties resulting from war activities, and the great increase in quarantine problems resulting from the many new ports, all offered enhanced opportunity for either or both introduction and spread, deliberate or accidental, of new or established pathogens.

National security restrictions prohibited discussion of malicious activity during the war, and even now consistency with wartime policies prevents the telling of certain phases of this work. However, while the specific purpose of the Project was not made public, it quickly became known in professional circles and among agricultural staff members in general that an alert, competent corps of pathologists was maintaining a vigilant watch on plant disease developments throughout the country. This fact, in itself, must have constituted substantial protection against would-be "inside job" saboteurs[2], since, unquestionably, malicious persons with sufficient technical knowledge of plant diseases to do damage early became aware of the protective measures being taken and the attendant personal danger of detection, as well as the likelihood that attempts at destructive use of plant diseases would be observed and brought under control.

Additional assurance against introduction of diseases with imported plant products was afforded by the parallel surveys conducted in the vicinity of ports of entry by inspectors of the Bureau of Entomology and Plant Quarantine.

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2 Of course this type of defensive activity could be only partially effective in recognizing and preventing destruction resulting from devices operating from a foreign base. In this connection, perhaps some readers will be interested in a book published in 1944 by the Current Publishing Company, entitled "Japan's Secret Weapon", by Barclay Newman.

METHODS

The actual field work was conducted, on the average for the two years, by 24 pathologists who were each so assigned to specific territories as to cover the entire continental United States (see Table 1). Special emphasis was placed in strategic locations, for example the West Coast and other areas of highly concentrated food production. Fortunately, it was possible in nearly every area to assign a person already familiar with the geography and cropping practice of the region in which he was to work. The coverage of important winter truck crop areas in Florida, Texas, and California was increased during the winter months by transfer of personnel from less active regions.

In all cases, the cooperating experiment station officials participated in planning itineraries and in obtaining assistance of county agents and of State workers in general, so that the production areas of the entire country were placed under observation.

In addition, two field laboratories, one at Beltsville, Maryland, the other at Stillwater, Oklahoma, were established, with competent consulting diagnosticians in charge, where baffling cases of plant diseases could be sent for identification and verification of the causal agents.

Attention was focused primarily upon important food crops, although an effort was made not to overlook disease developments upon other plants. The "G-men" of plant diseases, who were well versed in field diagnosis, were each furnished a car and spent most of their time in the field gathering and recording information as complete as possible regarding the plant disease situation within their respective territories. Weekly reports were prepared in duplicate. One copy went to the officials of the State where the observations were made, the other was sent to the Beltsville Station for suitable action.

Table 1. Field and laboratory technical staff of the Emergency Plant Disease Prevention Project, July 1, 1943, to June 30, 1945. (1) = first assignment. (2) = second assignment. (W) = winter assignment. * = duration of assignment less than three months. Regular assignments in capital letters; temporary assignments in lower case.

ALTSTATT, G. E.	TEXAS
ATKINSON, R. E.	NORTH and SOUTH CAROLINA (1); VIRGINIA and WEST VIRGINIA (2)
BAIN, DOUGLAS C.	LOUISIANA and MISSISSIPPI
BAINES, R. C.	ILLINOIS and INDIANA

BARNETT, H. L.	CALIFORNIA
BLODGETT, E. C.	IDAHO and eastern tier of counties in OREGON and WASHINGTON
BODINE, E. W.	COLORADO and WYOMING; California (W)
BOYLE, L. W.	WASHINGTON and OREGON
BRAUN, ALVIN J.	OHIO and MICHIGAN
BRETZ, T. W.	IOWA and MISSOURI (1); MISSOURI (2)
CASSELL, R. C.	NEW ENGLAND STATES (1); NEW YORK and PENNSYLVANIA (2)
HARRIS, HUBERT A.	MONTANA
HARRIS, M. R.	OHIO and MICHIGAN
HARVEY, JAMES V.	CALIFORNIA
HONEY, E. E.	WISCONSIN
HOYMAN, WM. G.	ARIZONA and NEW MEXICO
HYRE, RUSSELL A.	KENTUCKY and TENNESSEE; Florida (W)
JACKSON, JOHN R.	ALABAMA and GEORGIA*
LARSH, HOWARD W.	ARKANSAS and OKLAHOMA; TEXAS (W)
LOCKE, S. B.	NEVADA and UTAH; California (W)
MIX, A. J.	DELAWARE, MARYLAND, NEW JERSEY
NAGEL, CLATUS M.	IOWA*
NIEDERHAUSER, JOHN S.	NEW YORK and PENNSYLVANIA*
OLIVE, LINDSAY S.	BELTSVILLE, MD., IDENTIFICATION LABORATORY
PADY, S. M.	KANSAS and NEBRASKA; Texas (W)
PERSON, L. H.	LOUISIANA and MISSISSIPPI
PRESTON, D. A.	STILLWATER, OKLA., IDENTIFICATION LABORATORY
PRINCE, A. E.	NORTH and SOUTH CAROLINA
RAY, W. W.	STILLWATER, OKLA., IDENTIFICATION LABORATORY
RHOADS, A. S.	FLORIDA (1); NEVADA and UTAH (2)
SCHLATTER, F. P.	FLORIDA*
SCHNEIDER, HENRY	CALIFORNIA
SHANOR, LELAND	BELTSVILLE, MD., IDENTIFICATION LABORATORY
SLAGG, C. M.	Florida (W); MONTANA (1); KANSAS and NEBRASKA (2)
STONE, G. M.	ALABAMA and GEORGIA
TAYLOR, ALBERT L.	Nematode Survey in SOUTHERN STATES
TAYLOR, C. F.	VIRGINIA and WEST VIRGINIA
TERVET, IAN W.	MINNESOTA and NORTH and SOUTH DAKOTA
TIDD, J. S.	CALIFORNIA (1); INDIANA and ILLINOIS (2)
TYLER, L. J.	NEW YORK and PENNSYLVANIA
VESTAL, EDGAR F.	IOWA
WALKER, E. A.	DELAWARE, MARYLAND, NEW JERSEY
WATKINS, G. M.	TEXAS
WATSON, R. D.	TEXAS*

RESULTS

A just evaluation of the contribution made by the Emergency Survey must take into account the real reason for its establishment with the

attendant moral and financial obligation to adhere strictly to the primary aim, the absolute impossibility at any time to determine the Project's duration, the fact that the observations reported here were obtained incidentally to the main purpose of the Survey, the varying problems of different regions, and the still active effect of some of the findings. Considering all the factors affecting its operation, and all the use made of its results, we believe the Survey has presented concrete favorable evidence of the fundamental importance of this type of field investigation, whether during time of war or peace.

An indispensable prerequisite to the functioning of the Project, gratefully acknowledged and continually stressed by the field men in their reports, was the generous aid given by State personnel. State research, extension, and control programs benefited materially from the acquisition of data on which to base new investigation or to verify or change emphasis of established programs, but the benefit was mutual since the foundation of local knowledge necessary for effective reconnaisance was furnished by the State workers, who also took part in many of the surveys and helped to make reports more comprehensive by supplying missing data from their own observations.

The diversity in scope and content of the State surveys necessitated by fundamental differences in individual problems resulted in correspondingly varied products that do not fit very smoothly into a systematic presentation for the country as a whole. For this reason, mainly, a truer idea of the real value of the Survey can be gained from consideration of significant accomplishments of various types than from a general summary that would surely be inadequate.

The most obvious contribution was the specific information obtained on the presence and distribution of diseases, nationally and locally. Authenticity of the reports of new or unusual distribution was assured by the accurate determination of the organisms involved by the personnel of the two identification laboratories. Approximately 2500 plant disease specimens were submitted by the staff to the two field laboratories for diagnosis or verification. Those of sufficient interest and permanent value have been placed in the Mycological Collections of the Bureau of Plant Industry, Soils, and Agricultural Engineering.

Diseases that so far as could be determined were "new", i.e., not reported at all prior to this Survey, discovered in this country for the first time, or found on a new host, are listed in Table 2. As might be expected, the individual diseases differ greatly in importance. The discovery of the potato rot nematode in Idaho before it was too late to prevent unsuspected spread to other potato-growing areas is a major contribution to the welfare of the crop (see Blodgett's report in Appendix below). Other discoveries involved less menacing potentialities but were significant in various ways. Some probably represented sporadic occurrences dependent on exceptional local conditions.

Table 2. New diseases found during the Emergency Plant Disease Prevention Project surveys (previously undescribed diseases = *; diseases found in this country for the first time = **; diseases found on new hosts = ***)

Host Disease (Cause)	Where found	Remarks
Artichoke Dwarfing and mottling (? Virus)*	Calif.	
Asparagus Charcoal rot (*Macrophomina phaseoli*)***	Texas	
Bean and lima bean Witches'-broom (Undet., ? virus)*	Ariz.	Possibly caused by some already described virus
Bean, lima Leaf spot (*Ascochyta boltshauseri*)***	N. Car.	
Bean, mung Yeast spot of seed (*Nematospora coryli*)***	Okla.	
Broccoli White leaf spot (*Cercosporella albo-maculans*)***	Pa., and in market, origin unknown, Ind.	
Lettuce, eggplant, pepper Root rot (*Aphanomyces* sp.)*	N. J.	Found on lettuce seedlings in coldframes on one farm where it caused some loss; same fungus later found on eggplant and pepper seedlings in greenhouse on another farm; loss of pepper plants was heavy
Potato Potato rot nematode (*Ditylenchus destructor*)**	Idaho	On a few farms in one potato section

Host Disease (Cause)	Where found	Remarks
Potato Ring spot (Tomato ring spot virus)***	Col., Wyo.	
Spinach Root rot (Phytophthora megasperma)***	Calif., N. Car.	In California the fungus causes root rot on various other hosts but had not been found on spinach previously. The fungus had not been known to occur in North Carolina before.
Cowpea Stem blight (Diaporthe sojae)***	Va.	Fungus common as cause of stem and pod blight of soybean; not reported on cowpea before.
Target spot (Helminthosporium vignae)*	La., N. Car., S. Car.	Causes severe spotting of leaves; also on stems
Leaf spot (Myrothecium roridum)***	La.	One location. Fungus consistently isolated from a particular type of leaf spotting
Peanut Anthracnose (Colletotrichum sp.)*	Okla.	Isolated from stem lesions
Stem blight (Diaporthe sojae)***	Va.	
Soybean Target spot (Helminthosporium vignae)*		Causes light spotting on soybean leaves. See cowpea
Powdery mildew (Microsphaera sp.)**	N. Car.	
Leaf spot (Myrothecium roridum)***	La.	One location. See cowpea

Host Disease (Cause)	Where found	Remarks
Soybean		
Yeast spot of seed (*Nematospora coryli*)***	Okla., N. Car., S. Car., Va.	Cultures of seed from various sources indicate disease widespread. Causes discoloration of seeds; in severe cases seeds do not mature and are badly shriveled.
Seedling blight (*Penicillium* sp.)*	Ohio	Found on soybeans being tested for germination; strongly pathogenic in infection experiments.
Leaf spot (*Phyllosticta sojaecola*)**	Md., N.J.	Severe in many instances
Bacterial wildfire or halo blight (*Pseudomonas tabaci*)***	Found to be widespread in soybean areas	
Corn		
Bacterial leaf spot and top rot (undetermined bacterium)*	Kans., Nebr.	Potentially important under favorable conditions
Leaf striping (undetermined, ? virus)*[a]	Texas	Widely scattered in Lower Rio Grande Valley; more common on sweet and popcorn than field corn. Stunted bushy plants; green and white striped leaves with broad red or bronze longitudinal bands; production of ear shoots from lower nodes

[a] Kunkel (Proc. Nat. Acad. Sci. Wash. 32: 246-247. 1946) has designated this disease as "stunt" and demonstrated its transmission by the leafhopper *Baldulus maidis*. The disease reported from Calif. by Frazier (PDR 29: 212-213. Mar. 7, 1945) slightly earlier than Altstatt's report from Texas (PDR 29: 533-534. June 15, 1945) is the same disease according to Kunkel.

Host Disease (Cause)	Where found	Remarks
Oats		
"Mosaic-chlorosis" (virus)*	N. Car., S. Car.	Rather generally distributed in both States
Sorghum		
Leaf spot (Microdiplodia sp.)*	La.	In one experimental planting.
Apple and pear		
Leaf and fruit spot (Elsinoë piri)	Wash., Oreg.	First found in Washington on apple by Bureau of Entomology and Plant Quarantine inspectors. Distribution determined, as well as occurrence on pear, by Emergency Survey

Field men encountered more than 150 diseases affecting some 60 crops in States where they had not previously been known to occur. Many of these records amounted to a mere verification of expected occurrence. Most, however, made a definite addition to knowledge of geographical distribution of disease, either by filling in gaps in the known disease situation on certain crops, notably soybean; or by determining previously overlooked components in diseases of varied or complex origin, e. g., Cercospora zeae-maydis as a predominant cause of corn leaf spot in eastern Kentucky and Tennessee; or by recording a significant extension of range, striking examples in this category being the discovery of Macrophomina phaseoli in Oregon and of elm phloem necrosis in Kansas, Arkansas, and Oklahoma. Table 3 lists a representative selection. Most of the original records were reported currently in the PLANT DISEASE REPORTER.

Table 3. Some diseases found during the Emergency Plant Disease Prevention Project surveys in States where they had not previously been known to occur.

Host Disease (Cause)	State	Remarks
Cantaloup, pumpkin, squash		
Charcoal root rot (Macrophomina phaseoli)	Oreg.	First report of the fungus in this State or so far north

Host Disease (Cause)	State	Remarks
Carrot		
Bacterial blight (Xanthomonas carotae)	Idaho	First reported in 1943 although evidently present earlier
Lettuce		
"Brown blight" (virus)	Ind.	Had recently been described from Ill. Occurs in greenhouse
Onion		
Smut (Urocystis cepulae)	Colo.	
Pepper		
Phytophthora blight (P. capsici)	Mo., La.	
Potato		
Psyllid yellows (tomato psyllid)	S. Dak.	
Spinach		
White blister (white rust) (Albugo occidentalis)	Okla.	Known only in Texas before
Leaf spot (Heterosporium variabile)	Fla., Okla.	
Curly top ? (virus)	Okla.	Characteristic symptoms
Summer squash		
Phytophthora capsici	Mo.	
Sweetpotato		
Mottle necrosis (Pythium)	Calif.	
Tomato		
Spotted wilt (virus)	Ariz.	
Corn		
Leaf spot (Cercospora zeae-maydis)	Ky., Tenn.	Known only in Ill. before

Host Disease (Cause)	State	Remarks
Corn		
Zonate spot (Gloeocercospora zeae-maydis)	Miss.	
Leaf and stalk rot (Physalospora zeae)	Ind.	
Bacterial stalk rot (Phytomonas dissolvens)	Mo.	
Flax		
Root rot (Pythium aphanidermatum)	Ariz.	
Wilt (Sclerotinia sclerotiorum)	Tex., Calif.	
Sorghum		
Leaf spot (Ascochyta sorghina)	Okla.	
Sorghum and broom corn		
Leaf spot (Ramulispora sorghi) (Titaeospora andropogonis)	Okla., Ark.	
Wheat		
Leaf spot (yellow spot) (Helminthosporium tritici-vulgaris)	Kans., Nebr., Va., W.Va., N.&S.Car.	Had recently been found in this country, in N.Y. and Md.
Soybean		
Bud blight or top necrosis (virus resembling tobacco ring spot virus)	Ark., Mo., Kans., Nebr., Ill., Wis., Minn., S. Dak.	Previously observed in Ohio, Ind., Iowa
Cotton		
Ascochyta blight (A. gossypii)	La.	

Host Disease (Cause)	State	Remarks
Tobacco		
Anthracnose (Colletotrichum sp.)	Va.	Previously known in Md.
Ring spot (virus)	Mass.	
Peach and chokecherry X-disease (virus)	Ohio	
Strawberry Red stele (Phytophthora fragariae)	Me.	
Elm Phloem necrosis (Virus)	Kans., Ark., Okla.	Previously destructive in Ohio River Valley but west of Miss. River known only in southeastern Mo. Besides new States, disease was found in additional widely scattered locations in Mo.
Oak Wilt (Chalara quercina)	Mo.	

Some diseases were observed to be more widely distributed than previously realized in States where they were already known to be present. Among these, to mention only three, alfalfa bacterial wilt (Corynebacterium insidiosum) was found for the first time in the main alfalfa seed producing areas in Minnesota, its known range in Wisconsin also was extended northward, and in some other States it was found to be more prevalent and widespread than had been suspected. The onion bulb nematode (Ditylenchus dipsaci), which has been known for some time on a few farms in two locations in New York, was found in another district for the first time, in a small portion of one field. Careful surveys in Oklahoma showed that the omnivorous root rot organism, Phymatotrichum omnivorum, affected a somewhat larger area than had previously been determined in that State.

The detection of new and potentially important sources of damage

and the contributions to plant disease geography constitute only one aspect of the assistance given by the Emergency Program to crop production. In many activities the Project supplemented and cooperated in the work of established Federal and State agencies in studies on the epidemiology, incidence, and importance of specific plant diseases, forecasts and warnings of probable disease development during the season, identity and cause of obscure diseases, and determination of subjects requiring attention from research or extension workers. Reports of the Project field men usually did not mention the practical use made of their observations, but Barss (Some results of value to States from the Emergency Plant Disease Prevention Program in 1943 and 1944, compiled by Howard P. Barss. Unnumbered mimeographed publication issued by Office of Experiment Stations, U. S. Department of Agriculture) has compiled a list based on a questionnaire to heads of plant pathology departments at the State Experiment Stations, and Chupp also discussed some specific instances (Ways in which the Emergency Plant Disease Prevention Program aids extension. Plant Dis. Reptr. Suppl. 152: 3-5. Jan. 15, 1945).

Accomplishments of this portion of the Emergency program are illustrated by the following examples selected from hundreds of similar cases. They show that the plant disease situation during these war years presented opportunities for some exceptional services on the part of the Emergency organization.

That most famous and temperamental of plant disease actors, late blight (Phytophthora infestans), put on a sensational show in Southern States during the winter and spring, 1943-44. This performance rates headlines for its vivid interpretation of the varied interrelations of plant disease importance, not only in immediate, but in future consequences. It is not too far-fetched an assumption that the heavy late blight infection in 1943-crop northern seed potatoes planted in the South was the primary factor in the building-up of tomato late blight infection, culminating in the outbreak that caused so much consternation in some Northern States in 1946.

The epiphytotic is an excellent illustration both of the importance a disease can assume in wartime, and of the effects of war conditions on disease incidence and spread. The severity of the disease, both North and South, was tied up with various heavy war-connected demands on the potato crop superimposed on the regular consumption requirements. This excessive demand, with a certain amount of late blight in some Eastern areas operating as a minor factor, accounted for the much-discussed potato "famine" of early 1943, according to Weiss (PDR 27 (9): 203-206. May 15, 1943). The shortage affected not only table stock but seed potatoes as well. In order to obtain seed for the greatly expanded acreage, certification requirements were relaxed and much seed was planted that ordinarily would have been rejected. The 1943 crop in Northern seed potato States suffered a widespread late

blight outbreak, with heavy tuber infection; again, lowered standards were responsible for the planting of much of this infection-bearing seed in the South. In Southern States, weather ordinarily does not favor late blight regardless of seed infection, but during the 1943-44 season its cooperation assured the development of an outbreak, while control was hampered not only by grower unfamiliarity with the disease but by wartime scarcity and difficulty of obtaining control materials and equipment.

The disease was epiphytotic in every Gulf State from Texas to Florida, and north to South Carolina, and caused losses ranging from a quarter to half or more of the expected yield (Figure 1). In some of the affected areas, notably in Louisiana and Mississippi, it had rarely been present before.

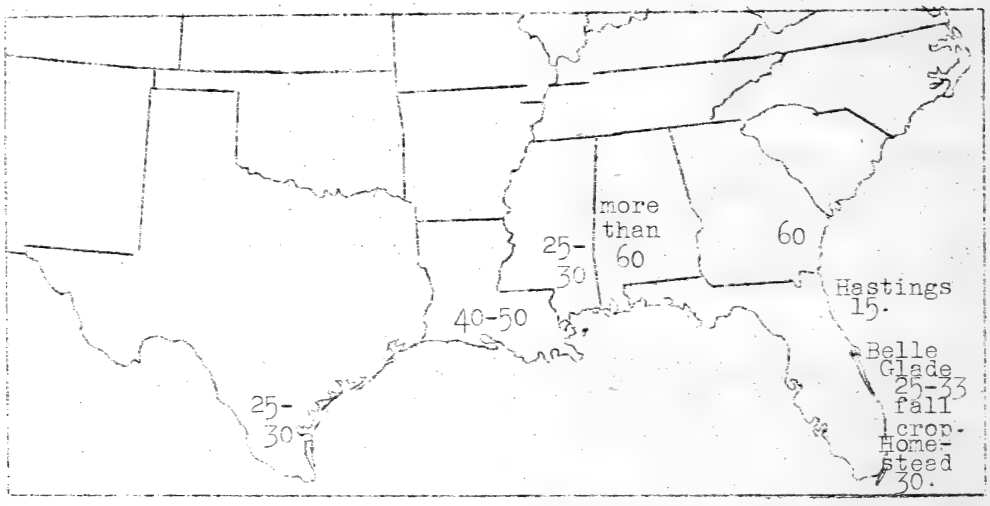

Figure 1. Estimated percentage loss from potato late blight during the 1943-44 epiphytotic in Southern States.

It is extremely unlikely that this outbreak could have been reported so completely and so promptly without organized effort. Observations on the appearance, development, and severity of the disease in Florida and Texas served as indication of its probable course in other Southern areas, if weather permitted, and alerted pathologists and growers in the absence of a warning service for this section of the country.

This southern outbreak furnishes a more concrete example of the application of current crop disease information to the forecasting of future developments. In the Lower Rio Grande Valley of Texas late blight was found to be widespread on the fall crops of both potato and tomato in late 1943 and early 1944. This was the first time in several

years that the disease had occurred on tomatoes in the Valley. The significant feature of its prevalence on the relatively small fall crop was the danger to the important spring crops, which were just being planted at that time and which overlapped the fall crops during the early stages of growth. The threat was so serious that growers were warned in time to undertake preventative measures. On the basis of this advance information a leading fungicide and insecticide dealer increased his fungicide order by a considerable amount[3]. The warning was fully justified by later developments. Weather remained favorable during the next three months and by March the disease had increased to epiphytotic proportions. In most undusted potato fields all of the foliage had been killed and the stems were dying by the middle of March, with a total loss of the crop of affected plants, since most were just approaching the flowering stage. The effectiveness of dusting was strikingly evident, but even with the stimulus for greater control activity only about half of the 10,000 acres planted to potatoes in this section were dusted.

The South was not the only area in which the Emergency Project contributed to the fight against late blight. Project field men in some States aided materially in the warning service conducted by the Upper Mississippi Valley Plant Pathologists' War Emergency Committee, both in field inspections and in a considerable amount of anonymous assistance in summarizing and correlating information on weather and disease occurrence.

The prominence during these years of some widely distributed plurivorous fungi and viruses, notably Macrophomina phaseoli (Sclerotium bataticola), Sclerotinia sclerotiorum, and the aster yellows virus, might not have been brought out without the aid of the Emergency Program, particularly since wartime conditions would have tended to reduce observations and reports in the absence of an organized effort to obtain them.

Distribution reported for Macrophomina phaseoli is shown in Figure 2. East of the Mississippi the records represent scattered occurrences on one or two hosts. In the Central and Southern Plains regions the root rot of corn and sorghum was apparently more prevalent and severe

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[3] In this connection, a substantial contribution was made by the field staff of the Emergency Project through close cooperation with the Chemical Division of the Chemical and Fertilizer Branch, Office of Materials and Facilities, War Food Administration. The Emergency staff acted as "official spotters" by furnishing information relative to approaching epiphytotics and local shortages of fungicides to the Chemical Division, which was charged with the responsibility for seeing that insecticides and fungicides were properly distributed to points where they were most needed by farmers. As a wartime conservation measure this activity repeatedly proved its worth.

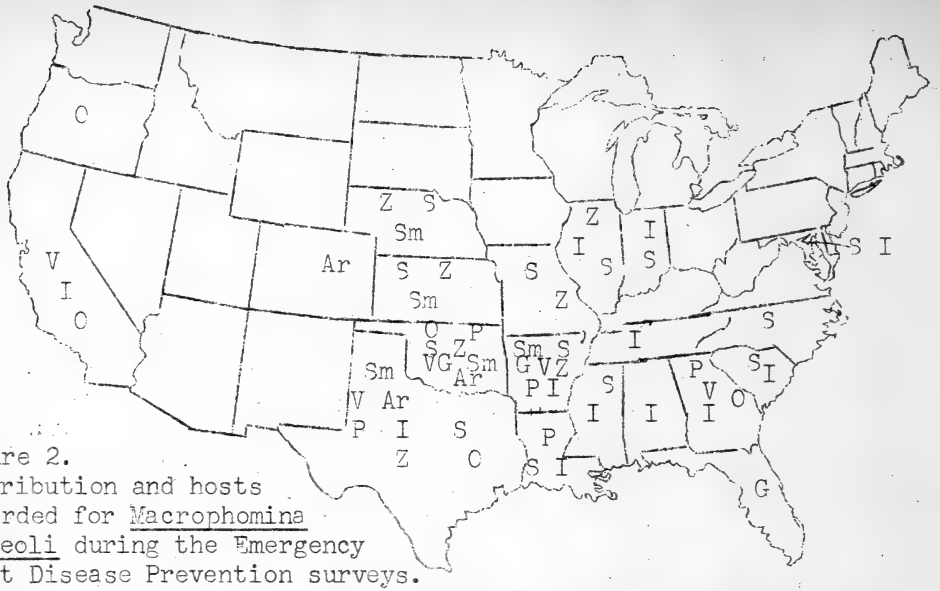

Figure 2. Distribution and hosts recorded for Macrophomina phaseoli during the Emergency Plant Disease Prevention surveys. Hosts: S (Soja), soybean; Sm (Sorghum), sorghum; V (Vigna), cowpea; Z (Zea) corn; P (Phaseolus), bean; I (Ipomoea) sweetpotato; Ar (Arachis) peanut; G (Gossypium) cotton; C, other hosts.

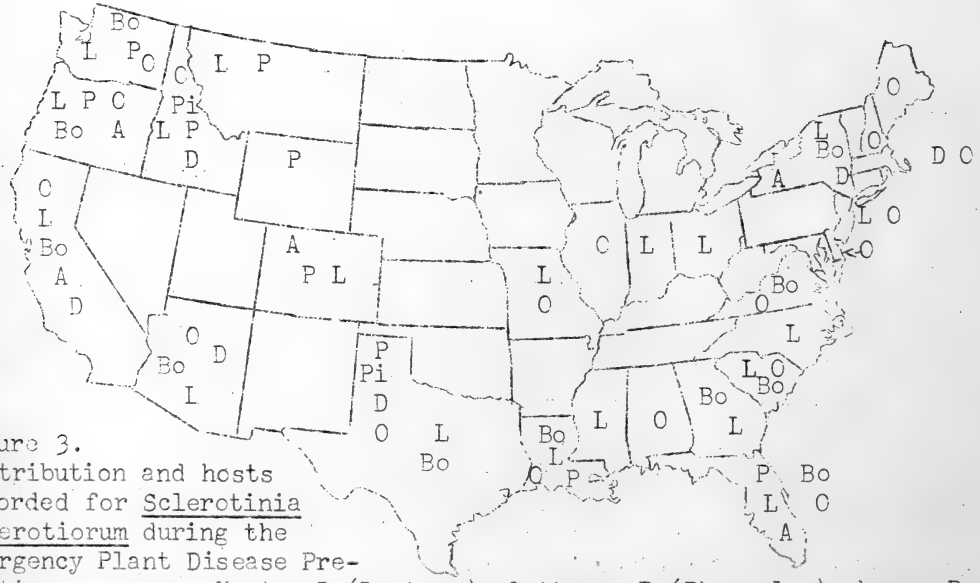

Figure 3. Distribution and hosts recorded for Sclerotinia sclerotiorum during the Emergency Plant Disease Prevention surveys. Hosts: L (Lactuca), lettuce; P (Phaseolus), bean; Bo (Brassica oleracea), cabbage and its relatives; A (Apium), celery; Pi (Pisum), peas; D (Daucus), carrot; C, other hosts.

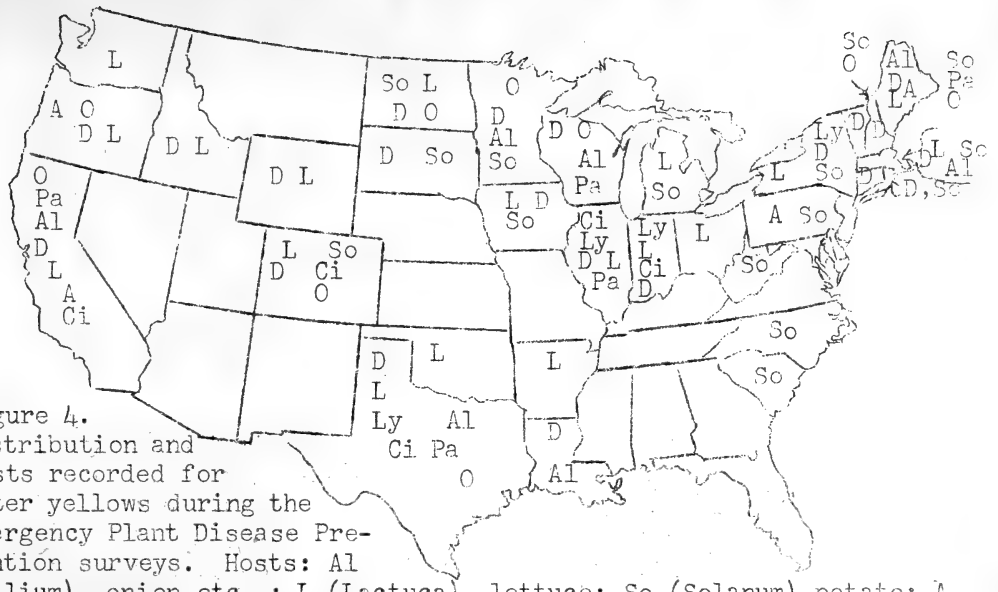

Figure 4.
Distribution and hosts recorded for aster yellows during the Emergency Plant Disease Prevention surveys. Hosts: Al (Allium), onion etc.,; L (Lactuca), lettuce; So (Solanum) potato; A (Apium), celery; D (Daucus) carrot; Ly (Lycopersicon), tomato; Ci (Cichorium), endive, escarole; Pa (Pastinaca), parsnip; O, other hosts

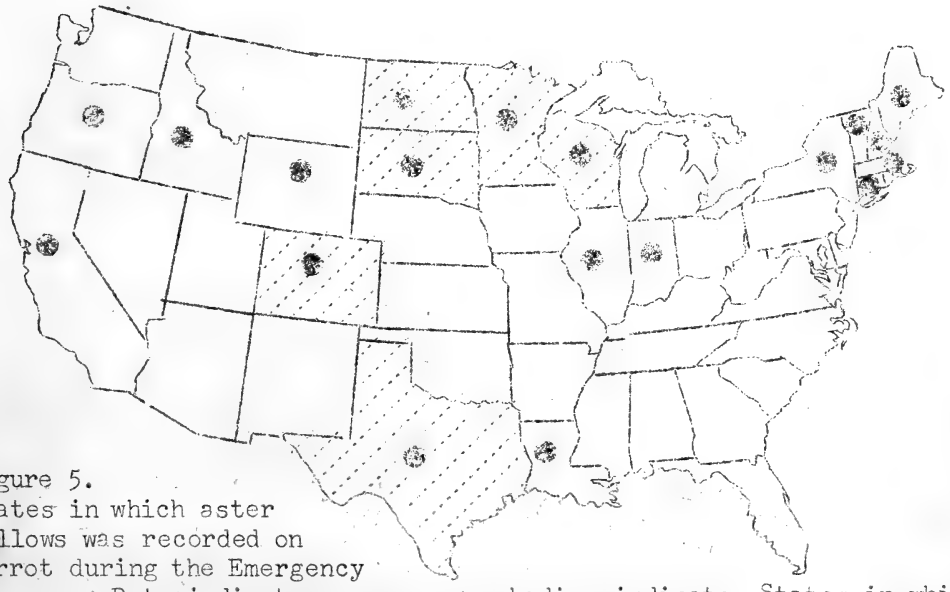

Figure 5.
States in which aster yellows was recorded on carrot during the Emergency surveys. Dots indicate occurrence; shading indicates States in which the disease was reported as a major factor in carrot growing.

than usual. In Oklahoma and north and east Texas incidence of the organism on numerous hosts amounted to an epiphytotic outbreak. The discovery of the fungus for the first time in Oregon marks a wide jump in its known distribution.

Although Sclerotinia sclerotiorum is widespread and important as the cause of various types of diseases on a wide range of hosts, it is seldom so generally recorded during any one year as it was during this survey (Figure 3). Outbreaks were recorded from Floride to Idaho, especially on beans, peas, lettuce, and cruciferous crops.

Aster yellows occurred widely on numerous hosts, (Figure 4) and was reported as a major disease in carrot-growing areas of several States (Figure 5).

As an example of intensive watch over the development of a disease in a limited crop region, the observations on aster yellows in the important carrot plantings in the Winter Garden region of Texas are outstanding. An outbreak characterized by Ivanoff and Ewart (PDR 28 (32): 972-979. Oct. 7, 1944) as "unprecedented" caused very heavy loss there during the 1943-44 crop season. Infection ranged from none in very young plantings to more than 80 percent in nearly mature fields, averaging 30 percent or more throughout the period. Increase in the staff of the Emergency survey in Texas winter crop areas by transfer of field men from more northern regions enabled cooperation in practically continuous inspection of carrot plantings, beginning with November when loss became so obvious as to alarm the growers. The surveys accumulated a fund of information on carry-over of the virus from one crop season to another; relation of infection to age of planting, abundance of insect vectors, and prevalence of infection in other hosts, especially weeds; effect of disease on roots; amount of loss from specific degrees of infection; varietal reaction; -- all subjects of fundamental importance to research and control programs and for determining the probable course of the disease in future seasons.

Another intensive series of surveys, during which regular examinations were made of vegetable farms in northern New Jersey, resulted in the discovery of an unusual seedling trouble of lettuce, eggplant, and pepper, caused by a fungus identified as a species of Aphanomyces. The disease, although destructive, was so restricted in distribution and so limited in duration that it might very well have been missed entirely except for the frequent inspection of plants from seedling stage to maturity (see Table 2).

Some examples representative of the type of fundamental information gained from surveys in various regions may be mentioned briefly. Virus diseases were shown to be more widely distributed and more common in Utah stone fruit orchards than had been realized, and a reliable

method was established of diagnosing rusty mottle of sweet cherry in the absence of the typical symptoms. Much progress was made toward determining the factors associated with the cause and spread of decline in citrus and avocado groves in California. Results of the nematode survey in Florida and other Southern States showed that, besides the root knot nematode, Heterodera marioni, many other plant parasitic forms about which very little is known are widespread and probably of considerable importance. A survey in Virginia and West Virginia showed that the meadow nematode, Pratylenchus pratensis, was very widely distributed and that it was constantly associated with winter browning of boxwood and probably was involved in much of the so-called winter injury of many plants. Bad infestations of both the root knot and meadow nematodes were found on celery in Oregon in locations where neither had been recognized as a cause of loss. Peanut disease surveys in the Carolinas, Georgia, and Alabama added a great deal to the available information on distribution of peanut diseases, varietal reaction, fungi associated with peg rot and nut rot in field and storage, and methods of harvesting and storage to reduce losses from nut deterioration.

A new approach to the control of seed-borne organisms causing seedling diseases and root rots of small grains was instituted by the Emergency work in Minnesota and the Dakotas. Seed of barley, oats, wheat, and flax, originating in widely distributed regions of these States, were cultured to determine whether the particular organisms present were of types that could be controlled by seed treatment and whether they occurred in such concentration as to justify treatment. This project produces long-range, not merely immediate, benefits, through saving expense of unnecessary seed treatment, preventing controllable losses in regions where seed treatment is advisable, and perhaps gradually eradicating some of the sources of loss.

Some of the most important contributions made by the Emergency Program pathologists were the intensive studies of stored crops. Direct importance to the war effort resulted from the conservation of much produce that otherwise would have been lost. For example, in Rhode Island a special study of rot and other disease conditions of potatoes in storages under the control of the War Food Administration enabled the local officials to move to market first the potatoes most subject to spoilage.

Of greater significance in the long run, however, was the better understanding of the whole storage problem made possible by the comprehensive information gained from these observations on storage construction and management, condition of crops as they went into storage, types of diseases present and their relative prevalence at different durations and under varying treatment in storage. Chupp (PDR Suppl. 152: 3-5. Jan. 15, 1945) points out that, whereas hitherto the need for investigation of storage problems had been recognized in a general

way, the Emergency Program studies raised specific questions for extension and research workers to answer.

Naturally, because of the widespread production of the crop, most general attention was paid to potatoes in the storage surveys. Potatoes were particularly affected by storage deterioration during the 1943-44 season. Repeated examinations in Maine demonstrated this especially well. Poor harvesting conditions, rough handling by scarce and inexperienced help, overloaded and improvised storages, aggravated the effects of rot-producing organisms and resulted in very heavy loss.

In Idaho, on potatoes in field and storage, either a new disease or a new serious aspect of a disease was found, to which the term "water rot" was applied. Repeated isolations from typical samples yielded a fungus identified at the Stillwater Laboratory as Phytophthora erythroseptica. In some fields at digging time as many as 50 percent of the tubers showed this trouble, and the amount of rot increased in storage. The cause of a similar trouble observed in Minnesota and the Dakotas has not been assigned as yet.

Seed potatoes, as well as table stock, in storage were examined. In one county of Wisconsin it was found that more than 60 percent of the potato growers were harboring bacterial ring rot (Corynebacterium sepedonicum) in their seed stocks. In close cooperation with the Wisconsin Extension Service and with research men, a special campaign was inaugurated to prevent the presence and spread of this disease. This study, which was conducted during two seasons, consisted of numerous storage inspections and interviews with the growers in which the importance of disease-free seed stock and sanitation as control measures was emphasized. The program was welcomed by all having to do with potato production in this area, and it doubtless contributed much toward increasing both the quality and quantity of the crop.

Other stored crops were not neglected. In various States, storage conditions affecting sweetpotato, squash, onions, carrots, celery, cabbage, rutabagas, apples, and pears were studied. In New York a series of particularly comprehensive and detailed investigations included both vegetables and fruits.

In this category of storage problems may be considered the serious difficulties presented by the 1944 corn crop in Iowa and Nebraska. A high percentage of the unusually large crop was immature and therefore especially subject to molding, while the size of the crop rendered storage facilities inadequate and much of the corn was stored in temporary cribs or piled in heaps on the ground. Damp weather aggravated the moisture situation; size of the crop and shortage of transportation prevented prompt shelling and marketing. In cooperative work with State officials, Survey pathologists gathered data on storage condi-

tions, moisture content, kinds and amount of molds present, and rate of spoilage, that resulted in recommendations for handling in such a manner as to use up the wettest corn first and to arrange storage to allow maximum ventilation, thus reducing molding as far as possible. Nevertheless, heavy loss resulted.

Appropriate material to illustrate the contributions of the Emergency Plant Disease Prevention Project might equally as well have been taken from many other examples instead of or in addition to those selected. It is impossible to mention, even briefly, all of the individual accomplishments. The foregoing account seems to us to include a representative choice. Reports of the surveys as they were made are published in the PLANT DISEASE REPORTER, beginning with Volume 27, number 15, 1943, through Volume 29, 1945.

CONCLUSIONS

In conclusion, it appears that the Emergency Plant Disease Prevention Program, in addition to its protective feature, was of definite value to wartime American agriculture by increasing the effectiveness of plant disease control programs throughout the country. It discovered previously unrecognized sources of severe crop losses, and by cooperating with research and extension agencies was instrumental in the application of control measures that will prevent recurrence of these losses in the future. In certain cases where effective control measures were not available the recognition of the trouble led to the undertaking of research designed to work out practical methods. The project also increased the effectiveness of disease control by early discoveries of incipient epiphytotics, and through a prompt forecasting service thus insured the application of preventive measures before it became too late. A number of new and potentially destructive diseases were discovered. They were called to the attention of the proper research and quarantine agencies so that they might be studied and watched as a necessary precaution against future losses.

APPENDIX

Shortly after the termination of the Emergency Plant Disease Prevention Project, members of the field staff were asked to prepare brief statements of what they considered to be the outstanding results of their efforts and to evaluate the non-confidential phases of their work. In keeping with the scheme adopted for the preceding text only selected parts of a few representative reports are given.

THE EMERGENCY PLANT DISEASE PREVENTION PROJECT IN IDAHO[1]

Earle C. Blodgett

The principal emphasis of this survey was placed on diseases affecting Idaho's main crops: potatoes, beans, wheat, alfalfa, fruits, vegetables and vegetable seeds. An actual appraisal of the value of the project is very difficult, and it is possible to indicate only briefly and generally some of the principal phases involved.

Probably the disease problem that was of the greatest interest and importance was the one on potatoes caused by a certain species of nematode, discovered on October 26, 1943, near Aberdeen. Since this discovery was due primarily to the Emergency Plant Disease Prevention Project the ultimate, intricate, and important ramifications may be credited to this Program. These may be listed as follows:

1. A disease was recognized as new to the United States and hence of considerable importance.

2. The causal agent was an undescribed species of nematode well known in Europe but previously confused with the bulb and stem nematode, Ditylenchus dipsaci.

3. The nematode was given the common name potato rot nematode, and the specific name Ditylenchus destructor Thorne, 1945. (Thorne, Gerald. Proc. Helminth. Soc. Wash. 12 (2): 27-33. 1945.)

4. A Nematode Control Committee composed of representatives of the U. S. Department of Agriculture, the Idaho Extension Service, the Idaho Agricultural Experiment Station at Moscow, the Aberdeen Branch Station at Aberdeen, the Idaho State Department of Agriculture, potato growers, potato dealers, and the Idaho Advertising Commission, was appointed by the Vice-Director of the Idaho Agricultural Experiment Station.

5. Extensive plans were set up for detailed surveys, strict control measures, and an intensive research program.

6. To furnish means for conducting this program, the Idaho State Legislature, in House of Representatives Bill No. 192 of the 28th Session, established the Plant Pest Control and Research Commission composed of the Governor, the Vice-Director of the Idaho Agricultural Experiment Station, and the Commissioner of Agriculture,

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[1] This note is written with the approval of the Plant Pest Control and Research Commission, State of Idaho

and authorized it to administer a $50,000 appropriation, half of which was set aside for research and for control of the potato rot nematode. Funds set aside by the U. S. Department of Agriculture, the Idaho Agricultural Experiment Station, the Aberdeen Branch Station, and the Idaho Advertising Commission brought the total to approximately $40,000 for the nematode program for a two-year period.

7. The entire control program recommended by the Committee was on a voluntary basis under strict requirements as to crop rotations and tuber disposal. It is quite certain that this method was as effective as quarantine measures would have been, and possibly more effective.

8. The research program was under the supervision of the writer in close cooperation with Gerald Thorne of the U. S. Department of Agriculture. The program included studies on crop rotations, variety testing, indexing land as to infestation, detailed surveys, and chemical control measures. In addition, a new water screening apparatus was designed and built, and operated to furnish new, fundamental information on transportation of nematodes by waste water from nematode-infested fields.

9. While much more remains to be learned through continued research it appears that the disease is well under control both from the standpoint of crop loss and of danger of spread.

The Survey Project from its very beginning has shown the value of cooperation. Close contact and counsel has been maintained with the members of the Western Plant Board and sound measures have been insisted upon to safeguard this State as well as others from the nematode disease. The establishment of a Plant Pest Control and Research Commission for Idaho was a very desirable step forward and probably would not have been accomplished without the emergency demands of the potato rot nematode problem.

The information gained through the Survey and in later work has called attention to the importance of the heretofore more or less neglected problems connected with the root knot and sugar beet nematodes. Recent developments indicate that the Nematode Control Committee will be responsible for an over-all nematode control program in the State. Improved practices in sugar beet dump dirt disposal will undoubtedly be established soon by the Committee's cooperation with the sugar company in designing new methods and machinery for the handling of this dirt, which is one of the principal methods by which nematodes, noxious weeds, and other pests are distributed from farm to farm.

The Survey can be credited with determining the cause of "water rot" of potatoes, with increasing the information on potato storage

diseases, with determining the cause of typical shell rot of potatoes. In general, it has furnished a good background for revision and concentration of efforts on research or extension problems in many phases of agriculture in the State. It is believed that the Survey was a direct benefit and filled a timely need.

HIGHLIGHTS OF THE EMERGENCY SURVEY IN KENTUCKY AND TENNESSEE

Russell A. Hyre

A most important contribution of the Survey was the obtaining of a comprehensive picture of the disease situation that could serve as a reliable basis for making adjustments in the research program to best meet the needs of the farmers. For instance, in western Tennessee, sweetpotato growers felt that if more help was not forthcoming stem rot (Fusarium) might deprive them of this important cash crop. Average yearly losses from stem rot now amount to 20 to 25 percent.

The educational contribution as a result of the Survey, in this area which lacked an extension pathologist, was considerable. Farmers, county agents, and others eagerly welcomed information on their plant disease problems.

The survey uncovered a leaf spot of corn caused by Cercospora zeae-maydis which was unreported from the Kentucky-Tennessee area and which, as far as is known, had been reported previously only from Illinois. The disease was found in ten counties in eastern Tennessee and Kentucky, seven in Tennessee and three in Kentucky. It occurred in severe form in some cases and was found on hybrid corn as well as on the open-pollinated varieties.

THE EMERGENCY SURVEY IN KANSAS

S. M. Pady

As far as Kansas is concerned, the most valuable contribution made by the Emergency Plant Disease Prevention Project was in obtaining complete data on the number, distribution, and prevalence of diseases known to be present in the State. Special emphasis was placed on the cereal diseases, and complete and detailed records were obtained on prevalence, particularly with regard to crop losses. For example, the milo disease of sorghums had previously been reported from only fifteen counties in western Kansas. Our surveys showed it to be present in eighteen counties widely distributed over the western part of the State. Bunt of wheat was found to be present in the State in

amounts small but sufficient to emphasize the importance of continuing seed treatments. Anthracnose of oats was reported for the first time and was found to be severe in 1945 on oats in southeastern Kansas. The new bacterial leaf spot and top rot of corn was found in trace amounts in many fields of eastern Kansas, but was particularly severe in certain inbred lines in seed production plots.

THE EMERGENCY SURVEY IN VIRGINIA AND WEST VIRGINIA

Carlton F. Taylor

I believe that the most important function of the Survey in this section was to supplement the activities of State workers in covering areas not normally visited by them. However, this was a decidedly non-spectacular phase.

In Virginia and West Virginia farms were selected at random along routes chosen to pass through areas of the most intensive cropping, such routes frequently being suggested by the County Agricultural Agent or other State worker. At each stop all available crops were examined and the farmer was encouraged to discuss any unusual crop troubles encountered either by himself or by his neighbors. By such means a boron deficiency disease of rutabagas causing an estimated annual loss of $20,000 in western Virginia was discovered. This information was placed at the disposal of the members of the Department of Plant Pathology at Virginia Polytechnic Institute, whose experiments during the following season confirmed the diagnosis and demonstrated that excellent control could be obtained by the addition of small amounts of boron.

ACCOMPLISHMENTS OF THE EMERGENCY SURVEY IN MINNESOTA AND THE DAKOTAS

Ian W. Tervet

Some of the most important benefits from the Emergency Program to the farmers resulted from the utilization of the knowledge obtained by the extension services to give more accurate controls for certain of the most important diseases. The surveys on the seed microflora of small grains proved of great value in emphasizing the continued need for seed treatment. Field surveys on cruciferous field crops indicated that much of the seed used was affected with pathogenic organisms, especially the black rot bacterium. This information led to the development of an extensive and successful hot water seed treatment campaign in Minnesota by Extension Pathologist R. C. Rose. Another major contribution was the rather detailed survey made on the presence of aster yellows virus on weeds and vegetable crops.

The surveys on purple top wilt and hair sprout of potato focused attention of some of the research workers on these problems.

The Survey observed and recorded a severe epiphytotic of pasmo disease of flax. Pasmo had caused only nominal loss since its introduction about 25 years ago until the summer of 1943. During that year, yellow-seeded varieties in southeastern North Dakota were destroyed and even the more resistant varieties such as Bison were severely injured in eastern South Dakota and Minnesota, losses to Bison running in excess of 50 percent in some fields.